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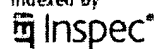
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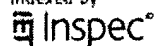
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Relevance scale ☐ ☐ ☐ ☐ ☐**1** [State of the art: Research challenges of autonomic computing](#)

Jeffrey O. Kephart

May 2005

Proceedings of the 27th international conference on Software engineering ICSE '05 , Proceedings of the 27th international conference on Software engineering ICSE '05

Publisher: ACM Press, IEEE Computer Society

Full text available: [pdf\(128.40 KB\)](#)[Publisher Site](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Autonomic computing is a grand-challenge vision of the future in which computing systems will manage themselves in accordance with high-level objectives specified by humans. The IT industry recognizes that meeting this challenge is imperative; otherwise, IT systems will soon become virtually impossible to administer. But meeting this challenge is also extremely difficult, and will require a worldwide collaboration among the best minds of academia and industry. In the hope of motivating researche ...

Keywords: autonomic computing, research challenges, self-managing systems**2** [Autonomic computing: emerging trends and open problems](#)

Mazeiar Salehie, Ladan Tahvildari

May 2005

ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(346.15 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The increasing heterogeneity, dynamism and interconnectivity in software applications, services and networks led to complex, unmanageable and insecure systems. Coping with such a complexity necessitates to investigate a new paradigm namely *Autonomic Computing*. Although academic and industry efforts are beginning to proliferate in this research area, there are still a lots of open issues that remain to be solved. This paper proposes a categorization of complexity in I/T systems and present ...

Keywords: autonomic computing, software engineering, software management**3** [A performance analysis method for autonomic computing systems](#)

Marin Litoiu

March 2007

ACM Transactions on Autonomous and Adaptive Systems (TAAS), Volume 2 Issue 1

Publisher: ACM Press

Full text available:  [pdf\(387.73 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In an *autonomic computing* system, an autonomic manager makes tuning, load balancing, or provisioning decisions based on a predictive model of the system. This article investigates performance analysis techniques used by the autonomic manager. It looks at the complexity of the workloads and presents algorithms for computing the bounds of performance metrics for distributed systems under *asymptotic* and *nonasymptotic* conditions, that is, with saturated and nonsaturated resou ...

Keywords: Self-management, autonomic computing, performance models

4 Supporting autonomic computing functionality via dynamic operating system kernel aspects



Michael Engel, Bernd Freisleben

March 2005 **Proceedings of the 4th international conference on Aspect-oriented software development AOSD '05**

Publisher: ACM Press

Full text available:  [pdf\(381.44 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

To master the complexity of software systems in the presence of unexpected events potentially affecting system operation, the *Autonomic Computing Initiative* [16] aims to build systems that have the ability to control and organize themselves to meet unforeseen changes in the hard- and software environment. The basic principles employed by autonomic computing are self-configuration, self-optimization, self-healing and self-protection. Typically, these principles are cross-cutting concerns, s ...

Keywords: NetBSD, autonomic computing, dynamic aspects, operating system kernel, organic computing

5 Workshop on architectural support for security and anti-virus (WASSA): Security in autonomic computing



David M. Chess

March 2005 **ACM SIGARCH Computer Architecture News**, Volume 33 Issue 1

Publisher: ACM Press

Full text available:  [pdf\(301.87 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Over the last fifteen years the world has experienced a wide variety of computer virus and general computer security problems, against which a wide variety of countermeasures have been deployed. The record tells us that what most strongly determines the size and nature of the worldwide virus and security problem is not any particular countermeasure or security technology, but rather the characteristics of the underlying platform (the operating system, macro execution environment, and so on). Aut ...

6 Autonomic computing: Requirements-driven design of autonomic application software



Alexei Lapouchnian, Yijun Yu, Sotirios Liaskos, John Mylopoulos

October 2006 **Proceedings of the 2006 conference of the Center for Advanced Studies on Collaborative research CASCON '06**

Publisher: ACM Press

Full text available:  [pdf\(454.68 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)
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Autonomic computing systems reduce software maintenance costs and management complexity by taking on the responsibility for their configuration, optimization, healing, and protection. These tasks are accomplished by switching at runtime to a different system behaviour - the one that is more efficient, more secure, more stable, etc. - while still fulfilling the main purpose of the system. Thus, identifying the objectives of the system, analyzing alternative ways of how these objectives can be met ...

7 OOPSLA onward! track chair's welcome: Applying a UML-based agent modeling

language to the autonomic computing domain

Ivan Trencansky, Radovan Cervenka, Dominic Greenwood

October 2006 **Companion to the 21st ACM SIGPLAN conference on Object-oriented programming systems, languages, and applications OOPSLA '06****Publisher:** ACM PressFull text available: pdf(205.59 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

As agent technology practitioners, some time ago we determined to develop an extension to UML 2.0 that addressed our specific needs, such as modeling autonomicity, proactivity and role-based behavior. We called this extension the Agent Modeling Language (AML) and have recently published the metamodel and specification for public use. In a recent project, we realized that AML could also be applied to the domain of autonomic computing and so decided to publish some of our findings in this paper. A ...

Keywords: AML, agent, agent-oriented software engineering, autonomic computing, autonomous system, modeling language, multi-agent system

8 Reconfigurable and autonomic computing: Using managed communication channels in software components



Emil Stoyanov, Markus Wischy, Dieter Roller

May 2006 **Proceedings of the 3rd conference on Computing frontiers CF '06****Publisher:** ACM PressFull text available: pdf(402.28 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The paper discusses the potential usage of principles from General System Theory (GST) and Cybernetics for design of Autonomic Software. Motivated by the characteristics of open systems and benefits of software communication management, we introduce the abstraction of Managed Communication Channels and propose general purpose architecture for composition and activation of communication channels. We illustrate examples of their application in different aspects of component oriented design for inc ...

Keywords: autonomic computing, managed communication, open systems, software evolution, software interoperability

9 A Multi-Agent Systems Approach to Autonomic Computing

Gerald Tesauro, David M. Chess, William E. Walsh, Rajarshi Das, Alla Segal, Ian Whalley, Jeffrey O. Kephart, Steve R. White

July 2004 **Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems - Volume 1 AAMAS '04****Publisher:** IEEE Computer SocietyFull text available: pdf(208.12 KB) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

The goal of autonomic computing is to create computing systems capable of managing themselves to a far greater extent than they do today. This paper presents Unity, a decentralized architecture for autonomic computing based on multiple interacting agents called autonomic elements. We illustrate how the Unity architecture realizes a number of desired autonomic system behaviors including goal-driven self-assembly, self-healing, and real-time self-optimization. We then present a realistic prototype ...

10 Transparent shaping of existing software to support pervasive and autonomic computing



S. Masoud Sadjadi, Philip K. McKinley, Betty H. C. Cheng

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4**Publisher:** ACM PressFull text available: pdf(409.76 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The need for adaptability in software is growing, driven in part by the emergence of

pervasive and autonomic computing. In many cases, it is desirable to enhance existing programs with adaptive behavior, enabling them to execute effectively in dynamic environments. In this paper, we propose a general programming model called *transparent shaping* to enable dynamic adaptation in existing programs. We describe an approach to implementing transparent shaping that combines four key software dev ...

Keywords: dynamic adaptation, middleware, program families

11 Emotions as a metaphor for altering operational behavior in autonomic computing

R. Chandarana, D. B. Skillicorn

October 2005 **Proceedings of the 2005 conference of the Centre for Advanced Studies on Collaborative research CASCON '05**

Publisher: IBM Press

Full text available:  pdf(222.89 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The ability to change operational behavior in response to changes in both external and internal environment is an important aspect of autonomic computing. Managing such behavioral changes is challenging. We propose emotions as a useful mechanism for understanding the structure and use of behavioral changes, and present the design and implementation of the Emotion System, a stand-beside environment for ordinary programs. Both the metaphor and the implementation are designed to make it easy for so ...

12 Policies, grids and autonomic computing



Bradley Simmons, Hanan Lutfiyya

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available:  pdf(142.05 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The goals of resource management fall within the overall aims of autonomic and grid computing, namely the sharing of resources automatically, and the allocation of resources depending on both application and business needs. Resource allocation can be guided by *policies* which encapsulate decisions made by the management system. Policies can be used to encapsulate many different types of management decisions including possible corrective actions when a performance requirement of an applicat ...

Keywords: autonomic computing, optimisation, policies, resource management

13 Frontmatter (TOC, Letters, Election results, Software Reliability Resources!, Computing Curricula 2004 and the Software Engineering Volume SE2004, Software Reuse Research, ICSE 2005 Forward)



July 2005 **ACM SIGSOFT Software Engineering Notes**, Volume 30 Issue 4

Publisher: ACM Press

Full text available:  pdf(6.19 MB) Additional Information: [full citation](#), [index terms](#)

14 Autonomic computing: Trust by design: information requirements for appropriate trust in automation



Pierre P. Duez, Michael J. Zuliani, Greg A. Jamieson

October 2006 **Proceedings of the 2006 conference of the Center for Advanced Studies on Collaborative research CASCON '06**

Publisher: ACM Press

Full text available:  pdf(112.67 KB)  htm(3.90 KB) Additional Information: [full citation](#), [abstract](#), [references](#)

Trust has, since the early stages of IBM's Autonomic Computing (AC) initiative, been recognized as an important factor in the success of new autonomic features. If operators do not trust the new automated tools, they will not use them -- no matter how useful or efficient they might be. Despite this stated awareness of trust as a major contributing factor to successful operator adoption of AC functionality (e.g., [11]), no clear process of explicitly designing for operator trust has emerged. The ...

15 Service delivery: SLA based profit optimization in autonomic computing systems



Li Zhang, Danilo Ardagna

November 2004 **Proceedings of the 2nd international conference on Service oriented computing ICSOC '04**

Publisher: ACM Press

Full text available: [pdf\(203.68 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

With the development of the Service Oriented Architecture (SOA), organizations are able to compose complex applications from distributed services supported by third party providers. Under this scenario, large data centers provide services to many customers by sharing available IT resources. This leads to the efficient use of resources and the reduction of operating costs. Service providers and their customers often negotiate utility based Service Level Agreements (SLAs) to determine costs and ...

Keywords: e-business, management, models, monitoring, quality, quality of service, reliability and availability, service, service delivery

16 Towards autonomic web services: achieving self-healing using web services



Sherif A. Gurguis, Amir Zeid

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(385.68 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Autonomic Computing was introduced to reduce the complexity of managing computing systems; however, the heterogeneous nature existing in most computing systems introduces some difficulty to achieve this target. Moreover, the notion of service as a computing component that seamlessly collaborates with other services in a loosely-coupled manner to perform complicated tasks was introduced by Service-Oriented Architecture (SOA); and then, fertilized by Web Services that added open standards to diffe ...

Keywords: MAPE-cycle, autonomic computing, autonomic web services, self-healing web services, web services

17 Papers: A self-testing autonomic container



Ronald Stevens, Brittany Parsons, Tariq M. King

March 2007 **Proceedings of the 45th annual southeast regional conference ACM-SE 45**

Publisher: ACM Press

Full text available: [pdf\(205.40 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Many strategies have been proposed to address the problems associated with managing increasingly complex computing systems. IBM's Autonomic Computing (AC) paradigm is one such strategy that seeks to alleviate system administrators from many of the burdensome tasks associated with manually managing highly complex systems. Researchers have been heavily investigating many areas of AC systems but there remains a lack of development in the area of testing these systems at runtime. Dynamic self-con ...

Keywords: autonomic computing, testing, validation

18 Industry perspectives: Toward autonomic computing with DB2 universal database

Sam S. Lightstone, Guy Lohman, Danny Zilio
September 2002 **ACM SIGMOD Record**, Volume 31 Issue 3

Publisher: ACM Press

Full text available: pdf(785.28 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

As the cost of both hardware and software falls due to technological advancements and economies of scale, the cost of ownership for database applications is increasingly dominated by the cost of people to manage them. Databases are growing rapidly in scale and complexity, while skilled database administrators (DBAs) are becoming rarer and more expensive. This paper describes the self-managing or autonomic technology in IBM's DB2 Universal Database® for UNIX and Windows to illustrate how self ...

19 Interoperability issues affecting autonomic computing

Dennis Smith, Edwin Morris, David Carney
May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: pdf(327.43 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Most autonomic systems consist of a number of components and systems. These systems require a high degree of interoperability between the constituent components and systems. We describe current research on the topic of interoperability that has relevance for autonomic systems and list a set of critical properties of interoperability that need to be considered in designing autonomic systems.

Keywords: autonomic computing, interoperability, self-managed systems

20 Industry track: Utility-based collaboration among autonomous agents for resource allocation in data centers

Rajarshi Das, Ian Whalley, Jeffrey O. Kephart
May 2006 **Proceedings of the fifth international joint conference on Autonomous agents and multiagent systems AAMAS '06**

Publisher: ACM Press

Full text available: pdf(332.21 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Autonomic computing, a proposed solution to the looming complexity crisis in IT, is a realm in which software agents and multi-agent systems can play a critically important role. Conversely, given its importance to a multi-billion dollar industry, it is fair to say that autonomic computing is a *killer app* for agents. Two years ago, we introduced Unity, an agent-based autonomic data center prototype that demonstrated the virtues of agency in autonomic computing applications. We discuss the ...

Keywords: autonomic computing, data centers, resource allocation, utility functions

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 Terms used **autonomic computing**

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 Relevance scale ☐ ☐ ☐ ☐ ☐

21 [M: Towards autonomic workflow management systems](#)



Markus Strohmaier, Eric Yu

 October 2006 **Proceedings of the 2006 conference of the Center for Advanced Studies on Collaborative research CASCON '06**

Publisher: ACM Press

 Full text available: [pdf\(51.08 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#)
[htm\(1.31 KB\)](#)

In a world of dynamic and discontinuous change, systems constantly need to adapt to new conditions so that they can survive and flourish in their environment. *Autonomic computing* emerged as a research field that takes up this challenge and aims to build systems that are capable of *adapting automatically to dynamically changing environments* (Self-configuring), *discovering, diagnosing and reacting to disruptions* (Self-healing), *monitoring and tuning resources automatically* < ...

22 [Graphical and visual information II: The use of eBooks and interactive multimedia as alternative forms of technical documentation](#)



Gord Davison, Steve Murphy, Rebecca Wong

 September 2005 **Proceedings of the 23rd annual international conference on Design of communication: documenting & designing for pervasive information SIGDOC '05**

Publisher: ACM Press

 Full text available: [pdf\(369.19 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The use of eBooks and interactive multimedia in technical documentation is an emerging and important trend for delivering abstract and complex technical information that is enticing, engaging, and -most important of all- effective. With the substantial (and growing) number of documents available electronically, it is a non-trivial task for technical writers to even reach their target audience, let alone engage them. Both eBooks and interactive multimedia feature unique characteristics that serve ...

Keywords: animation, audio, diagrams, documentation, eBook, graphic design, human factors, illustrations, user testing, visualization

23 [Autonomic Web-Based Simulation](#)

Yingping Huang, Gregory Madey

 April 2005 **Proceedings of the 38th annual Symposium on Simulation ANSS '05**

Publisher: IEEE Computer Society

 Full text available: [pdf\(264.78 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [index terms](#)

Many scientific simulations are large programs which despite careful debugging and testing

will probably contain errors when deployed to the Web for use. Based on the assumption that such scientific simulations do contain errors and the underlying computing systems do fail due to hardware or software errors, the authors investigate and explore robust methods for developing and deploying autonomic web-based simulations(AWS) based on the Vision of Autonomic Computing.

24 Challenges and opportunities in autonomic computing



Alfred Z. Spector

June 2002 **Proceedings of the 16th international conference on Supercomputing ICS '02**

Publisher: ACM Press

Full text available: [pdf\(122.64 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Significant advances are required to make systems more adaptive to the growing range of impulses affecting them and to reduce their total cost of management. Progress seems to require significant innovation in adaptive techniques, systems architecture, software engineering, and standards. In this presentation, I will survey the space of the requirements and draw example problems from real systems. I'll then discuss the space of our research at IBM and highlight some of the more compelling resear ...

25 Q focus: workflow systems: Under new management



Duncan Johnston-Watt

March 2006 **Queue**, Volume 4 Issue 2

Publisher: ACM Press

Full text available: [pdf\(605.32 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)
[htm\(29.20 KB\)](#)

Autonomic computing is revolutionizing the way we manage complex systems.

26 Towards requirements-driven autonomic systems design



Alexei Lapouchnian, Sotirios Liaskos, John Mylopoulos, Yijun Yu

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(414.43 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Autonomic computing systems reduce software maintenance costs and management complexity by taking on the responsibility for their configuration, optimization, healing, and protection. These tasks are accomplished by switching at runtime to a different system behaviour - the one that is more efficient, more secure, more stable, etc. - while still fulfilling the main purpose of the system. Thus, identifying and analyzing alternative ways of how the main objectives of the system can be achieved and ...

Keywords: autonomic computing software customization, goal-oriented requirements engineering, self-management, software variability

27 A survey of autonomic communications



Simon Dobson, Spyros Denazis, Antonio Fernández, Dominique Gaïti, Erol Gelenbe, Fabio Massacci, Paddy Nixon, Fabrice Saffre, Nikita Schmidt, Franco Zambonelli

December 2006 **ACM Transactions on Autonomous and Adaptive Systems (TAAS)**, Volume 1 Issue 2

Publisher: ACM Press

Full text available: [pdf\(300.86 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Autonomic communications seek to improve the ability of network and services to cope with unpredicted change, including changes in topology, load, task, the physical and logical characteristics of the networks that can be accessed, and so forth. Broad-ranging autonomic solutions require designers to account for a range of end-to-end issues

affecting programming models, network and contextual modeling and reasoning, decentralised algorithms, trust acquisition and maintenance---issues whose soluti ...

Keywords: Autonomic communication

28 Embedded, ubiquitous, and adaptive systems: An extensible, lightweight architecture for adaptive J2EE applications



Ian Gorton, Yan Liu, Nihar Trivedi

November 2006 **Proceedings of the 6th international workshop on Software engineering and middleware SEM '06**

Publisher: ACM Press

Full text available: pdf(566.62 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Server applications with adaptive behaviors can adapt their functionality in response to environmental changes, and significantly reduce the on-going costs of system deployment and administration. However, developing adaptive server applications is challenging due to the complexity of server technologies and highly dynamic application environments. This paper presents an architecture framework, known as the *Adaptive Server Framework* (ASF). ASF provides a clear separation between the imple ...

Keywords: J2EE, adaptation, component, software architecture

29 Towards the Knowledge-Driven Benchmarking of Autonomic Communications

David Lewis, Declan O'Sullivan, John Keeney

June 2006 **Proceedings of the 2006 International Symposium on on World of Wireless, Mobile and Multimedia Networks WOWMOM '06**

Publisher: IEEE Computer Society

Full text available: pdf(185.81 KB) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Currently a wide range of different adaptive and intelligent system solutions are being proposed for use in self-managing or autonomic networks. However, there are few means by which such proposals can be compared. This paper proposes that a benchmark be developed for autonomic systems so that progress in this field can be more systematically evaluated. Our approach assumes that autonomic systems make use of and thus expose a knowledge based representation of the service they offer, the context ...

30 OOPSLA onward! track chair's welcome: A commensalistic software system



Sebastian Fleissner, Elisa Baniassad

October 2006 **Companion to the 21st ACM SIGPLAN conference on Object-oriented programming systems, languages, and applications OOPSLA '06**

Publisher: ACM Press

Full text available: pdf(1.01 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The development of reliable software is a challenging task, especially in a business environment that forces developers to focus on meeting tight deadlines instead of producing quality software. Researchers and practitioners are exploring various approaches for addressing this problem, such as autonomic computing and conscientious autopoietic software. These approaches describe software systems that are capable of managing and preserving themselves. In this paper, we propose a new, concrete self ...

Keywords: autonomic computing, autopoietic software, symbiosis

31 Intelligent storage: Cross-layer optimization for soft real-time workload



Youjip Won, Hyungkyu Chang, Jaemin Ryu, Yongdai Kim, Junseok Shim

August 2006 **ACM Transactions on Storage (TOS)**, Volume 2 Issue 3

Publisher: ACM Press

Full text available: pdf(1.45 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In this work, we develop an intelligent storage system framework for soft real-time applications. Modern software systems consist of a collection of layers and information exchange across the layers is performed via well-defined interfaces. Due to the strictness and inflexibility of interface definition, it is not possible to pass the information specific to one layer to other layers. In practice, the exploitation of this information across the layers can greatly enhance the performance, reliability ...

Keywords: Intelligence, autonomic computing, boosting, cross layer optimization, file system, machine learning, multimedia, storage

32 Workshop on the Design and Evolution of Autonomic Application Software (DEAS 2005): DEAS 2005: workshop on the design and evolution of autonomic application software

David Garlan, Marin Litoiu, Hausi A. Müller, John Mylopoulos, Dennis B. Smith, Kenny Wong
May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software**
DEAS '05, Volume 30 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(292.56 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)



Understanding software engineering issues for autonomic computing systems is critical for the software and information technology sectors, which are continually challenged to reduce the complexity of their systems. To be autonomic, a system must know itself as well as its boundaries and its environment, configure and reconfigure itself, continually optimize itself, recover or heal from malfunction, protect itself, and function in a heterogeneous world---while keeping its complexity hidden from t ...

Keywords: autonomic computing, self-managed systems

33 Workshops: DEAS 2005: workshop on the design and evolution of autonomic application software

David Garlan, John Mylopoulos, Marin Litoiu, Dennis B. Smith, Hausi A. Müller, Kenny Wong
May 2005 **Proceedings of the 27th international conference on Software engineering ICSE '05 , Proceedings of the 27th international conference on Software engineering ICSE '05**

Publisher: ACM Press, IEEE Computer Society

Full text available:  [pdf\(151.34 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)
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Understanding software engineering issues for autonomic computing systems is critical for the software and information technology sectors, which are continually challenged to reduce the complexity of their systems. To be autonomic, a system must know itself as well as its boundaries and its environment, configure and reconfigure itself, continually optimize itself, recover or heal from malfunction, protect itself, and function in a heterogeneous world-while keeping its complexity hidden from the ...

Keywords: autonomic computing, self-managed systems

34 Reactive provisioning of backend databases in shared dynamic content server clusters

Gokul Soundararajan, Cristiana Amza
December 2006 **ACM Transactions on Autonomous and Adaptive Systems (TAAS)**,
Volume 1 Issue 2

Publisher: ACM Press

Full text available:  [pdf\(928.76 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper introduces a self-configuring architecture for on-demand resource allocation to

applications in a shared database cluster. We use a unified approach to load and fault management based on data replication and reactive replica provisioning. While data replication provides scaling and high availability, reactive provisioning dynamically allocates additional replicas to applications in response to peak loads or failure conditions, thus providing per application performance. We design an e ...

Keywords: Autonomic systems, databases, query processing, transactions

35 Topology based automation of distributed applications management



Umesh Bellur

January 2004 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 4th international workshop on Software and performance WOSP '04**, Volume 29 Issue 1

Publisher: ACM Press

Full text available: [pdf\(294.12 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

With the widespread use of distributed computing in the enterprise, there have been significant advances in development paradigms for these applications. Server side component models have considerably simplified development and the complexity has now shifted to the operational side of these applications. The increase in operational complexity has reached a point where it is no longer feasible for humans to manage the applications required to run an enterprise. The initial steps to provide self m ...

Keywords: Physical Design

36 A Framework for the Deployment of Self-Managing and Self-Configuring Components in Autonomic Environments



Eleni Patouni, Nancy Alonistioti

June 2006 **Proceedings of the 2006 International Symposium on on World of Wireless, Mobile and Multimedia Networks WOWMOM '06**

Publisher: IEEE Computer Society

Full text available: [pdf\(192.33 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Over the last two decades, the advent of the Internet coupled with the diverse philosophy of networks, formed the basis for a pervasive computing environment. In the latter, the current trend is defined by the concept of autonomic computing and communications, which lies in the introduction of automated functions that enhance the intelligence of existing computing and communication systems. This concept forms a new paradigm of systems with selfware capabilities that will automatically adapt thei ...

37 <username>, i need you!: initiative and interaction in autonomic systems



Piotr Kaminski, Priyanka Agrawal, Holger Kienle, Hausi Müller

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(316.78 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)



In this position paper, we examine factors, such as trust and usability, which can affect the adoption of an autonomic system. We argue that a system that exhibits initiative and strong communication skills is more likely to be adopted, and propose to treat humans as modeled, managed elements in an autonomic control loop to achieve these goals. We then propose some synergistic design ideas to make communicating with users more effective, and to allow the system to learn from the users' actions.

Keywords: adoptability, autonomic computing, initiative, interaction, trust

38 Autonomic computing: Functionality configuration for eHome systems

 Ulrich Norbistrath, Christof Mosler
 October 2006 **Proceedings of the 2006 conference of the Center for Advanced Studies
 on Collaborative research CASCON '06**

Publisher: ACM Press

Full text available:  [pdf\(558.97 KB\)](#)
 [htm\(1.64 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#)

New developments and decreasing costs of electronic appliances enable the realization of pervasive systems in our daily environment. In our work, we focus on eHome systems. The price of individual development and adaption of the software making up these systems is one of the major problems preventing their large-scale adoption. In this paper, we introduce an approach built upon functionality composition for automatic service configuration in different environments. We transform the repetitive de ...

39 Reconfigurable and autonomic computing: An opportunistic reconfiguration strategy for environmentally powered devices

 Igino Folcarelli, Alex Susu, Ties Kluter, Giovanni De Micheli, Andrea Acquaviva
 May 2006 **Proceedings of the 3rd conference on Computing frontiers CF '06**


Publisher: ACM Press

Full text available:  [pdf\(503.61 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Environmental energy is becoming a feasible alternative to traditional energy sources for ultra low-power devices such as sensor nodes and smart watches. Moreover, the increasing need for flexibility and reconfigurability of such devices makes its energy management even more challenging. As a result, to efficiently exploit the potentially unlimited environmental energy, new adaptation strategies are required. In this paper we present a novel system reconfiguration strategy that exploits the intr ...

Keywords: reconfiguration, scavenging, sensor network

40 Reconfigurable and autonomic computing: REPLICA2Pro: task relocation by bitstream manipulation in virtex-II/Pro FPGAs

 Heiko Kalte, Mario Porrmann
 May 2006 **Proceedings of the 3rd conference on Computing frontiers CF '06**

Publisher: ACM Press

Full text available:  [pdf\(848.16 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

One vision of dynamic hardware reconfiguration is to deliver virtually unlimited hardware resources to a set of hardware tasks implementing arbitrary functions. By using partial reconfiguration, these tasks can be allocated and de-allocated on the reconfigurable architecture while others continue to operate. However, the exact placement of each task can only be determined during runtime according to the current resource allocation. This requires relocating each task from its original position af ...

Keywords: FPGA, bitstream manipulation, reconfigurable computing, task relocation

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- 41 [Learning Classifier systems and other genetics-based machine learning: papers: On-line evolutionary computation for reinforcement learning in stochastic domains](#)



Shimon Whiteson, Peter Stone

July 2006 **Proceedings of the 8th annual conference on Genetic and evolutionary computation GECCO '06**

Publisher: ACM Press

Full text available: [pdf\(704.41 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In *reinforcement learning*, an agent interacting with its environment strives to learn a policy that specifies, for each state it may encounter, what action to take. Evolutionary computation is one of the most promising approaches to reinforcement learning but its success is largely restricted to *off-line* scenarios. In *on-line* scenarios, an agent must strive to maximize the reward it accrues *while it is learning*. *Temporal difference* (TD) methods, another approach ...

Keywords: evolutionary computation, neural networks, on-line learning, reinforcement learning

- 42 [Research summaries: A coordination mechanism for self-healing and self-optimizing disciplines](#)



Mazeiar Salehie, Ladan Tahvildari

May 2006 **Proceedings of the 2006 international workshop on Self-adaptation and self-managing systems SEAMS '06**

Publisher: ACM Press

Full text available: [pdf\(72.94 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

There is an increasing demand for autonomic systems, which offer controlling complexity through a decentralized, multi-discipline and policy-based paradigm. In practice, only one discipline is often taken into account, while having shared resources and policies, it is required to coordinate different disciplines. This research addresses the problem of coordinating self-healing and self-optimizing in autonomic elements by generic modelling of disciplines, and proposing a coordination mechanism.

Keywords: autonomic computing, coordination

- 43 [Web, e-business and programming languages: Application performance prediction in autonomic systems](#)



Shobhana Kirtane, Jim Martin

March 2006 **Proceedings of the 44th annual Southeast regional conference ACM-SE**

44

Publisher: ACM PressFull text available:  pdf(142.70 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

An autonomic system is an intelligent system that is capable of self-configuration, self-healing, and self-management. Application performance prediction is a powerful tool that can be used in an autonomic system. Predicting application performance based on current or anticipated conditions provides fine-grained information that increases the chances that the autonomic manager makes correct decisions. In this paper, we report on the design and implementation of a system that can be used by an au ...

Keywords: application prediction, autonomic systems, intelligent systems**44** [Program analysis and reverse engineering: STAC: software tuning panels for](#) [autonomic control](#)


Elizabeth Dancy, James R. Cordy

October 2006 **Proceedings of the 2006 conference of the Center for Advanced Studies on Collaborative research CASCON '06****Publisher:** ACM PressFull text available:  pdf(1.16 MB)  htm(2.37 KB) Additional Information: [full citation](#), [abstract](#), [references](#)

One aspect of autonomic computing is the ability to identify, separate and automatically tune parameters related to performance, security, robustness and other properties of a software system. Often the response to events affecting these properties consists of adjusting tuneable system parameters such as table sizes, timeout limits, restart checks and so on. In many ways these tuneable parameters correspond to the switches and potentiometers on the control panel of many hardware devices. While m ...

45 [Query processing: A characterization of the sensitivity of query optimization to](#) [storage access cost parameters](#)

Frederick R. Reiss, Tapas Kanungo

June 2003 **Proceedings of the 2003 ACM SIGMOD international conference on Management of data SIGMOD '03****Publisher:** ACM PressFull text available:  pdf(255.35 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Most relational query optimizers make use of information about the costs of accessing tuples and data structures on various storage devices. This information can at times be off by several orders of magnitude due to human error in configuration setup, sudden changes in load, or hardware failure. In this paper, we attempt to answer the following questions: • Are inaccurate access cost estimates likely to cause a typical query optimizer to choose a suboptimal query plan? • If an optimizer ...

Keywords: autonomic computing, computational geometry, databases, parametric query optimization, storage systems**46** [Industry track: The role of agents in enterprise system management: a position paper](#) 

Onn Shehory

May 2006 **Proceedings of the fifth international joint conference on Autonomous agents and multiagent systems AAMAS '06****Publisher:** ACM PressFull text available:  pdf(267.03 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The size and complexity of enterprise computer systems are growing rapidly. As a result, system management has become increasingly difficult and expensive. In fact, management costs are typically estimated at 50%-70% of the total cost of ownership. Despite large investments in management software and personnel, enterprise computer systems are usually managed sub-optimally. This situation calls for a fundamental change in the way systems are managed. Recent studies suggest that systems manage them ...

47 Models: Architecture-based self-adaptation in the presence of multiple objectives

 Shang-Wen Cheng, David Garlan, Bradley Schmerl
May 2006 **Proceedings of the 2006 international workshop on Self-adaptation and self-managing systems SEAMS '06**

Publisher: ACM Press

Full text available:  [pdf\(390.41 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In the world of autonomic computing, the ultimate aim is to automate human tasks in system management to achieve high-level stakeholder objectives. One common approach is to capture and represent human expertise in a form executable by a computer. Techniques to capture such expertise in programs, scripts, or rule sets are effective to an extent. However, they are often incapable of expressing the necessary adaptation expertise and emulating the subtleties of trade-offs in high-level decision mak ...

Keywords: choice, preference, repair language, self-adaptation, strategy, tactic, trade-off, utility

48 Adaptive integration of third-party web services

 Giovanni Denaro, Mauro Pezzé, Davide Tosi
May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4


Publisher: ACM Press

Full text available:  [pdf\(392.06 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Service based computing allows clients to dynamically bind services, and providers to modify the service implementation independently from their clients. The impossibility of statically determining which service implementation will be bound at runtime may lead to unexpected client-side failures. This position paper suggests a scenario in which service-based applications autonomously react to changes in the implementation of the used services, automatically detect possible integration mismatches, ...

Keywords: integration faults, self-adaptive service oriented architecture, web services

49 Cases from the field: Field studies of computer system administrators: analysis of system management tools and practices

 Rob Barrett, Eser Kandogan, Paul P. Maglio, Eben M. Haber, Leila A. Takayama, Madhu Prabaker

November 2004 **Proceedings of the 2004 ACM conference on Computer supported cooperative work CSCW '04**

Publisher: ACM Press

Full text available:  [pdf\(405.09 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Computer system administrators are the unsung heroes of the information age, working behind the scenes to configure, maintain, and troubleshoot the computer infrastructure that underlies much of modern life. However, little can be found in the literature about the practices and problems of these highly specialized computer users. We conducted a series of field studies in large corporate data centers, observing organizations, work practices, tools, and problem-solving strategies of system admi ...

Keywords: collaboration, command-line interfaces, ethnography, situation awareness, system administration

50 Autonomic WWW server management with distributed resources

Takuya Araki

October 2004 **Proceedings of the 2nd workshop on Middleware for grid computing**

MGC '04**Publisher:** ACM PressFull text available: pdf(593.40 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

If many people access a Web server at one time, the server might not be able to respond within an acceptable time or even provide the service. Therefore, enough servers should be assigned to a service to guarantee quality of service. But reserving a lot of resources for peak access is not cost effective, because these resources are idle most of the time.

In order to solve this problem, technologies called utility computing or autonomic computing have been proposed and are under develop ...

51 Manageability: An approach to benchmarking configuration complexity

Aaron B. Brown, Joseph L. Hellerstein

September 2004 **Proceedings of the 11th workshop on ACM SIGOPS European workshop: beyond the PC EW11****Publisher:** ACM PressFull text available: pdf(107.71 KB) Additional Information: [full citation](#), [abstract](#), [references](#)

Configuration is the process whereby components are assembled or adjusted to produce a functional system that operates at a specified level of performance. Today, the complexity of configuration is a major impediment to deploying and managing computer systems. We describe an approach to quantifying configuration complexity, with the ultimate goal of producing a configuration complexity benchmark. Our belief is that such a benchmark can drive progress towards self-configuring systems. Unlike trad ...

52 Adaptation in middleware: A middleware for autonomic QoS management based on learning

Patrice Vienne, Jean-Louis Sourrouille

September 2005 **Proceedings of the 5th international workshop on Software engineering and middleware SEM '05****Publisher:** ACM PressFull text available: pdf(166.47 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In any system, applications compete for a limited amount of resources. As long as there are enough resources, resource sharing based on a best effort policy is satisfactory. When resources become scarce, the system gives rise to uncontrol-lable degradations. From a global view of the system and according to the degrees of freedom of applications, Quality of Service (QoS) managers aim to adapt application behavior to deal with overload effects. This paper proposes a middleware for autonomic QoS ma ...

Keywords: QoS Management, QoS management, middleware, reinforcement learning

53 The C-Cube framework: developing autonomic applications through web services


Gerardo Canfora, Piero Corte, Antonio De Nigro, Debora Desideri, Massimiliano Di Penta, Raffaele Esposito, Amedeo Falanga, Gloria Renna, Rita Scognamiglio, Francesco Torelli, Maria Luisa Villani, Paolo Zampognaro

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4**Publisher:** ACM PressFull text available: pdf(300.45 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Web services constitute a promising technology to support autonomic computing. Automatic discovery of new services, their composition and binding based on Quality of Service (QoS) are just some of the most promising features that can be provided using web services. In other words, a service oriented system is able to automatically discover, bind, and use, at run time, the services that, among those available, offer a given piece of functionality with a QoS compatible with the system non-function ...


Keywords: automatic service discovery, automatic service negotiation, run-time binding, service replanning, service-oriented systems

54 A software architecture approach for structuring autonomic systems

 Dharini Balasubramaniam, Ron Morrison, Graham Kirby, Kath Mickan, Brian Warboys, Ian Robertson, Bob Snowden, R. Mark Greenwood, Wykeen Seet

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(877.64 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Autonomic systems manage themselves given high-level objectives by their administrators. They utilise feedback from their own execution and their environment to self-adapt in order to satisfy their goals. An important consideration for such systems is a structure which is conducive to self-management. This paper presents a structuring methodology for autonomic systems which explicitly models self-adaptation while separating functionality and evolution. Our contribution is a software architecture ...

Keywords: autonomic systems, change, evolver, feedback, producer, software architectures, structuring

55 Architectural design of a distributed application with autonomic quality requirements

 Danny Weyns, Kurt Schelfhout, Tom Holvoet


May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(428.69 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

An autonomic system is essentially characterized by quality requirements that specify that the system should be able to adapt itself (configure optimize, heal, etc.) under varying circumstances and situations. These quality requirements call for an architecture centric software engineering approach. In this paper, we discuss and illustrate the architectural design of a complex real-world distributed application with autonomic quality requirements. In particular, we present an architecture with a ...

56 Web system-oriented performance: Load prediction models in web-based systems

 Mauro Andreolini, Sara Casolari

October 2006 **Proceedings of the 1st international conference on Performance evaluation methodologies and tools valuetools '06**

Publisher: ACM Press

Full text available:  [pdf\(379.21 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

Run-time management of modern Web-based services requires the integration of several algorithms and mechanisms for job dispatching, load sharing, admission control, overload detection. All these algorithms should take decisions on the basis of present and/or future load conditions of the system resources. In particular, we address the issue of predicting future resource loads under real-time constraints in the context of Internet-based systems. In this situation, it is extremely difficult to ded ...

57 Self-Sizing of Clustered Databases

Christophe Taton, Sara Bouchenak, Noel De Palma, Daniel Hagimont, Sylvain Sicard

June 2006 **Proceedings of the 2006 International Symposium on on World of Wireless, Mobile and Multimedia Networks WOWMOM '06**

Publisher: IEEE Computer Society

Full text available:  [pdf\(235.71 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Distributed software environments are increasingly difficult to manage. This paper presents a middleware for the development of self-manageable and autonomic systems. Preliminary experiments for automatically adapting a cluster of replicated databases according to QoS requirements are reported.

58 A curriculum for embedded system engineering



Rudolph E. Seviora

August 2005 **ACM Transactions on Embedded Computing Systems (TECS)**, Volume 4 Issue 3

Publisher: ACM Press

Full text available: [pdf\(116.62 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The paper presents a curriculum for a 4-year undergraduate program in Embedded System Engineering (ESE). The curriculum was developed using a two-step approach. First, a body of education knowledge for Embedded System Engineering was defined. The body consists of sixteen knowledge areas. Each area is composed of several knowledge units, some designated as core and others as electives. The minimum lecture time for the core of each knowledge area is identified. The Body of Knowledge for Computer E ...

Keywords: Embedded system engineering, Embedded system engineering curriculum, Undergraduate engineering curriculum

59 Retrofitting networked applications to add autonomic reconfiguration



Michael G. Merideth, Priya Narasimhan

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(409.16 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

To reduce user maintenance is an important goal for applications that must dynamically adapt based on their environments. There are many existing popular applications that lack support for this autonomic reconfiguration, but that are beginning to be used in these dynamic environments, in which they must update themselves frequently; not all of these applications will be completely redesigned and redeveloped in order to support autonomic features. In this paper, we explore how to retrofit pre-exi ...

Keywords: autonomic, intrusion detection, reconfiguration, software upgrades

60 Better performance or better manageability?



Mohammad A. Munawar, Paul A. S. Ward

May 2005 **ACM SIGSOFT Software Engineering Notes , Proceedings of the 2005 workshop on Design and evolution of autonomic application software DEAS '05**, Volume 30 Issue 4

Publisher: ACM Press

Full text available: [pdf\(321.09 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Competition among software providers creates enormous pressure on design and development teams to improve application performance. However, increased performance leads to systems whose behaviour is harder to predict. This in turn makes software harder to manage, or self-manage in the case of autonomic software. In this paper we elaborate on this problem, first in generic terms, and then taking memory-usage monitoring in a Java Virtual Machine as a specific example. We motivate the need for more ...

Keywords: autonomic computing, dynamic systems, self-management

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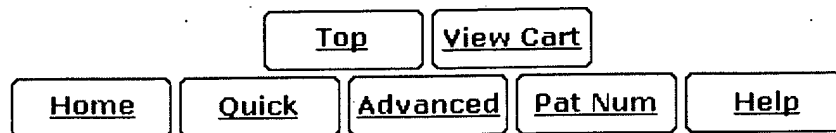
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